CLAIMS

1. A method for transferring a plurality (I) of independent optical signals $\{S_i\}$ through an optical channel having two ends, the method comprising the steps of:

(a) generating a plurality (I) of independent pseudorandom bit sequences (PRBSs);

(b) modulating a preselected optical mode of the i^{th} independent optical signal S_i according to the i^{th} independent pseudorandom bit sequence $PRBS_i$ to form an i^{th} modulated optical signal MS_i, where $i = \{1, \ldots I\}$;

(c) combining a plurality (I) of the modulated optical signals $\{MS_i\}$ to form an optical multiplex signal;

(d) transmitting the optical multiplex signal through the optical channel from one end to the other end;

(e) modulating the preselected optical mode of the optical multiplex signal according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form an i^{th} modulated multiplex signal MMS_i; and

(f) passing the i^{th} modulated multiplex signal MMS_i through a mode filter, whereby the independent optical signal S_i is recovered.

2. The method of claim 1 wherein the preselected optical mode comprises an optical polarization mode.

3. The method of claim 2 wherein the optical channel comprises an optical waveguide.

4. The method of claim 3 wherein the optical channel comprises a fiber optical channel.

5. The method of claim 2 wherein the optical channel comprises free space.

6. The method of claim 5 wherein the plurality (I) of independent PRBSs are mutually orthogonal.

7. The method of claim 2 wherein the plurality (I) of independent PRBSs are mutually orthogonal.

8. The method of claim 1 wherein the optical channel comprises an optical waveguide.

9. The method of claim 8 wherein the plurality (I) of independent PRBSs are mutually orthogonal.

10. An apparatus for transferring a plurality (I) of independent optical signals $\{S_i\}$ through an optical channel having two ends, the apparatus comprising:

a first pseudorandom bit sequence (PRBS) generator for generating a plurality (I) of independent PRBSs;

a plurality (I) of electro-optical modulators each coupled to the PRBS generator and disposed for modulating the polarization mode of the i^{th} optical signal S_i according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form a modulated optical signal MS_i, where $i = \{1, \ldots I\}$;

an optical combiner disposed at one end of the optical channel for combining a plurality (I) of the modulated optical signals $\{MS_i\}$ to form an optical multiplex signal for transmission through the optical channel;

at least one electro-optical modulator coupled to the PRBS generator and disposed at the other end of the optical channel for modulating the polarization mode of the optical multiplex signal according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form an i^{th} modulated multiplex signal MMS_i; and

a polarized filter disposed at the other end of the optical channel for filtering the i^{th} modulated multiplex signal MMS_i, whereby the independent optical signal S_i is recovered.

11. The apparatus of claim 10 further comprising:

a second PRBS generator disposed at the other end of the optical channel; and

correlator means for correlating the PRBSs from the second PRBS generator with the PRBSs from the first PRBS generator.

12. The apparatus of claim 11 further comprising:

an optical splitter disposed at the other end of the optical channel for splitting the optical multiplex signal to form a plurality (I) of optical multiplex signal copies $\{MSC_i\}$;

a plurality (I) of electro-optical modulators, each coupled to the second PRBS generator and disposed at the other end of the optical channel for modulating the polarization mode of the i^{th} multiplex optical signal copy MSC_i according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form a modulated multiplex signal MMS_i; and

a plurality (I) of polarized filters, each disposed at the other end of the optical channel for filtering the i^{th} modulated multiplex signal MMS_i, whereby the plurality (I) of independent optical signal $\{S_i\}$ are recovered.

13. The apparatus of claim 12 wherein the optical channel comprises an optical waveguide.

14. The apparatus of claim 13 wherein the optical channel comprises a fiber optical channel.

15. The apparatus of claim 11 wherein the optical channel included mode distortion and at least one independent optical signal S_P is transmitted through the optical channel, the apparatus further comprising:

distortion recovery means for recovering the optical channel mode distortion from the independent optical signal S_P.

16. The apparatus of claim 15 wherein the optical channel comprises free space.

17. The apparatus of claim 10 wherein the optical channel comprises an optical waveguide.

18. The apparatus of claim 17 wherein the optical channel comprises a fiber optical channel.

19. The apparatus of claim 10 wherein the optical channel comprises free space.

20. The apparatus of claim 10 wherein the plurality (I) of independent PRBSs are mutually orthogonal.

21. An apparatus for generating, from a plurality (I) of independent optical signals $\{S_i\}$, an optical multiplex signal suitable for transmission into an optical channel, the apparatus comprising:

a pseudorandom bit sequence (PRBS) generator for generating a plurality (I) of independent PRBSs;

a plurality (I) of electro-optical modulators each coupled to the PRBS generator and disposed for modulating the polarization mode of the i^{th} optical signal S_i according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form a modulated optical signal MS_i, where $i = \{1, \ldots I\}$; and

an optical combiner disposed at one end of the optical channel for combining a plurality (I) of the modulated optical signals $\{MS_i\}$ to form the optical multiplex signal for transmission through the optical channel.

22. The apparatus of claim 21 wherein the optical channel comprises an optical waveguide.

23. The apparatus of claim 22 wherein the optical channel comprises a fiber optical channel.

24. The apparatus of claim 21 wherein the optical channel comprises free space.

25. The apparatus of claim 21 wherein the plurality (I) of independent PRBSs are mutually orthogonal.

26. An apparatus for receiving, from an optical channel, an optical multiplex signal representing a plurality (I) of independent optical signals $\{S_i\}$ and for recovering therefrom an independent optical signal S_i, the apparatus comprising:

receiving means for accepting the optical multiplex signal from the optical channel;

a first pseudorandom bit sequence (PRBS) generator for generating a plurality (I) of independent PRBSs;

at least one electro-optical modulator coupled to the PRBS generator for modulating the polarization mode of the optical multiplex signal according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form an i^{th} modulated multiplex signal MMS_i; and

a polarized filter for filtering the i^{th} modulated multiplex signal MMS_i, whereby the independent optical signal S_i is recovered.

27. The apparatus of claim 26 wherein a second PRBS generator is disposed at the other end of the optical channel, the apparatus further comprising:

correlator means for correlating the PRBSs from the first PRBS generator with the PRBSs from the second PRBS generator.

28. The apparatus of claim 27 further comprising:

an optical splitter for splitting the optical multiplex signal to form a plurality (I) of optical multiplex signal copies $\{MSC_i\}$;

a plurality (I) of electro-optical modulators, each coupled to the first PRBS generator for modulating the polarization mode of the i^{th} multiplex optical signal copy MSC_i according to the i^{th} pseudorandom bit sequence $PRBS_i$ to form a modulated multiplex signal MMS_i; and

a plurality (I) of polarized filters for filtering the i^{th} modulated multiplex signal MMS_i, whereby the plurality (I) of independent optical signal $\{S_i\}$ are recovered.

29. The apparatus of claim 28 wherein the optical channel comprises an optical waveguide.

30. The apparatus of claim 29 wherein the optical channel comprises a fiber optical channel.

31. The apparatus of claim 27 wherein the optical channel included mode distortion and at least one independent optical signal S_P is transmitted through the optical channel, the apparatus further comprising:

distortion recovery means disposed at the other end of the optical channel for recovering the optical channel mode distortion from the independent optical signal S_P.

32. The apparatus of claim 31 wherein the optical channel comprises free space.

33. The apparatus of claim 26 wherein the optical channel comprises an optical waveguide.

34. The apparatus of claim 33 wherein the optical channel comprises a fiber optical channel.

35. The apparatus of claim 26 wherein the optical channel comprises free space.

36. The apparatus of claim 26 wherein the plurality (I) of independent PRBSs are mutually orthogonal.